Year XX November & December 1946 Nos. 11 & 12

INTERNATIONAL INSTITUTE OF AGRICULTURE
BUREAU OF THE F.A.O. AT ROME

INTERNATIONAL BULLETIN OF PLANT PROTECTION

PUBLISHED MONTHLY

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ROME
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INTERNATIONAL BULLETIN
OF PLANT PROTECTION

Year XX November & December 1946 Nos. 11 & 12

EFFECT OF NITROGENOUS FERTILIZERS ON GALLS CAUSED ON CASTOR-OIL PLANTS BY *BACTERIUM TUMEFACIENS* *

In continuing the investigations begun by O. VERONA on the effect of mineral intake on plant health, I wanted to ascertain the comparative action of certain nitrogenous salts on the development of galls caused by *Bacterium tumefaciens* Smith et Townsend on castor-oil plants.

Strictly speaking and from this general viewpoint, the action of nitrogenous salts is sufficiently well known for it to be affirmed that, as a rule, nitrogenous fertilizers promote, together with the vegetative vigour of the plants, the development of a large number of parasites, even if this action varies in relation to the soil composition, plant species and nature of the ground.

Little, however, is known about the connection between nitrogenous fertilizer and the development of galls produced by *Bact. tumefaciens* and the few experiments made on the subject appeared controverted.

The experiments briefly described here, summing up the technique and results, were carried out on pot cultivated plants of *Ricinus*, and in three different types of soil: sandy, clayey and mould, having the physico-chemical characteristics indicated in Table I:—

TABLE I. — Summary physico-chemical characteristics of the soils used in the experiments (average of several analyses).

Type of soil	Humidity %	Organic matter %	*p*H	$CaCO_3$ %
Sandy soil	0.84	5.45	7.8	4.60
Clayey soil	7.16	8.41	8	5.25
Mould	7.20	15.36	7.1	1.18

* Communication from Dr. GINO FLORENZANO of the Phytopathological Observatory (Plant Pathology Section) attached to the Plant Pathology Institute, Florence, Italy, presented by Prof. CESARE SIBILIA, Director of these institutions.

Each series of pots containing respectively the sandy and clayey soils and mould, were divided into groups; each group comprised pots with:

(*a*) no fertilizer addition (control);
(*b*) decomposed manure in the proportion of 600 qls. per hectare;
(*c*) potassium nitrate at the rate of 2 qls. per ha.;
(*d*) calcium cyanamide at the rate of 4 qls. per ha.;
(*e*) ammonium sulphate at the rate of 6 qls. per ha.

The manure and calcium cyanamide were added shortly before sowing; the ammonium sulphate at the time of sowing and the potassium nitrate as top dressing, in two applications 20 days apart.

Germination was regular. In each pot were left 5 seedlings selected from those with the most uniform growth. When these seedlings had grown sufficiently, they were inoculated by injecting with a sterile needle at a point corresponding to the insection of the cotyledons on the stem, a virulent culture of *Bact. tumefaciens*.

These inoculations succeeded a hundred percent. and the galls were visible from the ninth day after contamination.

During growth the seedlings of the diverse groups differed appreciably depending on the kind of soil and type of fertilizer applied.

Similar differences were evident as regards the development of the galls, as can be seen from the result of observations and the weights given in part in Table II.

TABLE II. — Average weight of plants freed from galls and air-dried and of galls dried in the air and at 110°C.

Medium	Fertilizer	Air-dried plants average weight in gm.	Average weight in gm. of galls	
			air-dried	dried at 110°C.
Series *S*	Control (S_1)	5.504	11.120	1.864
	Manure (S_2)	15.652	10.420	1,816
(sand)	KNO_3 (S_3)	10.345	8.970	1.786
	$Ca\ CN_2$ (S_4)	12.027	11.155	1,930
	$(NH_4)_2\ SO_4$ (S_5)	5.130	10.260	1.866
Series *A*	Control (A_1)	3,875	6.015	1.257
	Manure (A_2)	6.126	5.318	1.112
(clay)	KNO_3 (A_3)	3.480	6.564	1.369
	$Ca\ CN_2$ (A_4)	9.984	10.137	2.048
	$(NH_4)_2\ SO_4$ (A_5)	3.966	4.912	0.995
Series *T*	Control (T_1)	15.450	7.945	1.393
	Manure (T_2)	10.745	5.710	1.019
(mould)	KNO_3 (T_3)	9.966	3.078	0.733
	$Ca\ CN_2$ (T_4)	8.751	4.392	0.855
	$(NH_4)_2\ SO_4$ (T_5)	8.281	5.110	0.875

The data just given were obtained from material partly represented in figures 1, 2 and 3.

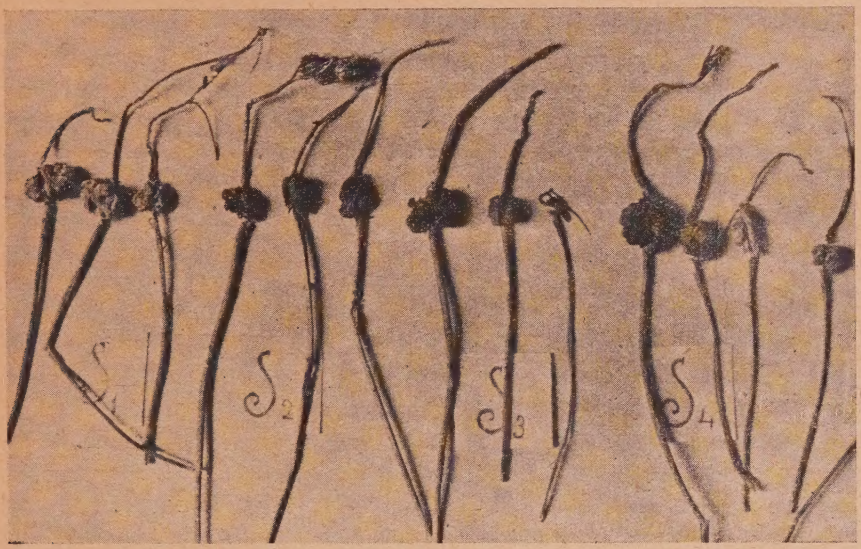

FIG. 1. — Galls produced by *Bacterium tumefaciens* on plants of *Ricinus* cultivated in sand

The experiments effected for the first time in 1942 were repeated in 1944 and the results fully agreed.

It is to be noted that if the type of investigations carried out, on the one hand, reproduces the natural conditions of certain farm lands, on the other, it makes the task of interpreting the results very difficult. Numerous factors simultaneously played a role in which the field of action cannot be defined, although the following general conclusions can be drawn from the observations made :—

(1) The general growth of the plants was best in the pots containing mould and the worst in those with clay.

(2) In the series with sand, the fertilizers, save ammonium sulphate, had a favourable action on plant growth.

(3) In the pots containing clay, the development of the plants was practically the same, with the exception of those given manure and calcium cyanamide where growth was definitely superior to the average.

(4) In the pots with mould, the different fertilizers had a marked depressing action on vegetation.

(5) In every case the galls were larger on the plants grown in sand (fig. 1) than those grown in mould and clayey soil (fig. 2 and 3).

FIG. 2. — Galls caused by *Bact. tumefaciens* on *Ricinus* plants grown in clayey soil.

FIG. 3. — Galls due to *Bact. tumefaciens* on *Ricinus* plants cultivated in mould.

The effect of the different fertilizers on the development of the galls varied according to the type of soil: in mould they had a perceptibly unfavourable action, while in the sandy and clayey soils they caused the formation, compared to the control plants, of slightly smaller galls and, in some cases (for example, with calcium cyanamide) larger ones.

In general, it may be said from the examination of the data assembled that the favourable or unfavourable action manifested by the fertilizers varies according to the nature of the soil. This last statement confirmed by further experiments could explain the controverted ideas evinced on this question.

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BEHAVIOUR OF *SPHACELOTHECA SORGHI*, CAUSAL AGENT OF COVERED SMUT OF SORGHUM, ON SWEET SORGHUM CULTIVATED IN ITALY *

About ten years ago there was a certain amount of apprehension in Italian farming circles as regards the advance of *Sphacelotheca sorghi* (Link) Clinton, causal organism of covered smut on sweet sorghum, since the cultivation of this industrial plant, for predominant reasons of national economy, was playing a truly important part.

The first crop seasons showed, what had already been ascertained from early experiments, that sorgo finds agricultural conditions in Italy very favourable, and it is an established fact by now that wherever the environment is favourable for the crop, it is equally suitable for *Sphacelotheca*. It is also known that the damage caused by this parasite is in this case high, amounting to 30-40 per cent.

Many experiments have been carried out on covered smut of sorghum abroad, but the particulars which can be obtained on the subject of receptivity of each of the species or varieties, conditions of development of the infection and consequently, the intensity of infection, are only of informative value and can only furnish approximate data, in so far as the behaviour of sorgo plants in regard to *Sphacelotheca* attack varies considerably according to the agricultural environment in which the plants live, either because of the influence of the different ecological factors on *Sphacelotheca* as on all infective diseases, or because of the physiological characteristics of this fungus, in which heterothallism and mutation phenomena give rise to species which present not only different morphological characteristics, but also different degrees of pathogenesis.

If it is added that in Italy foreign species, derived from American and Asiatic species, and even new types, are cultivated, the utility of these researches aiming at establishing the following points, is understood :—

(1) Can *Sphacelotheca sorghi* cause as much damage to the crop in Italy as abroad ?

(2) Are there any highly resistant varieties ?

(3) Do the main cultivation methods affect the pathological character ? How ?

(4) Does the disease affect, and if so to what extent, the chief qualities from the industrial standpoint, namely, the sugar content and weight of the stripped cane ?

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* Communication from Prof. Dr. GABRIELE GOIDÀNICH, Plant Pathology Station, Rom and Dr. VITTORIO SCARDOVI, Plant Pathology Institute, Bologna, Italy.

The sorgo varieties employed in the investigations (1939-40) were: ' Adria ', ' Atlas ', ' Black Amber ', ' Colman ', ' Early Orange ', ' Gooseneck ', ' Hasting ', ' Honey ', ' Kansas ', ' Japanese Ribbon ', ' Minnesota ', ' Orange Nero ', ' Planter ', ' Red Amber ', ' Rosso Lombardo ', ' Spargolo ', ' Vienna ', to which were added in the second year: ' Ambra Cinese ', ' Ambra Minnesota ', ' Nero precoce Lombardo ', ' Sugar Drip ' and ' Sumac '.

It is very evident (see table) that in Italy infection percentages are high (as much as 40 per cent. and over), as is the case in other regions where this plant is cultivated.

As indicated in the table, the ' Atlas ' variety is the most susceptible; others, like ' Gooseneck ', ' Spargolo ' and ' Vienna ' show a medium resistance.

In general, however, infection remains within economically tolerable limits.

Mineral fertilizers have a very variable action. Calcium cyanamide and superphosphates reduced the percentage of infected plants, while the nitrates had no effect.

Percentage of sorgo plants attacked by *Sphacelotheca sorghi* and cultivated in artificially inoculated plots :—

Variety	1° (1939) % diseased	2° (1939) % diseased	3° (1940) % diseased
' Adria '	0	5	—
' Ambra Cinese '	—	—	4
' Ambra Minnesota '	—	—	5 ½
' Atlas '	36	40.5	24
' Colman '	15	8	—
' Orange '	11	18	0
' Gooseneck '	21	36	0.7
' Hasting '	2	1	0
' Honey '	1	1	4.4
' Kansas '	2	16	0.8
' Japanese Ribbon '	1	6	2.4
' Nero precoce Lombardo '	—	—	3.1
' Orange Nero '	—	8	—
' Planter '	16	18	5
' Rosso Forlì '	—	—	5.5
' Rosso Lombardo '	3	3	3.8
' Seed '	—	—	5.2
' Sugar Drip '	—	—	3.7
' Sumac '	—	—	0.7
' Vienna '	15.6	8	3.1
' Early Orange '	—	18	0
' Spargolo '	25	11	0

Early sowing checked the appearance of the disease while late sowing favoured it (fact which is connected with the environmental conditions during the germination period of the grain, period when the penetration of the parasite takes place).

Refractometric analysis of the ripe cane (examination made on the third internode starting from the base) did not indicate any differences between the healthy and the diseased plants ; on the other hand, the weight of the cane was found to be less, owing to a reduced development in height and swelling of the diseased plant ; this reduction in height was not compensated by the growth of extra stems.

THE POTATO ROT NEMATODE *DITYLENCHUS DESTRUCTOR* *

This potato disease was first observed near Aberdeen, Idaho, in October 1943, by Dr. E. C. BLODGETT who was then employed by the Emergency Plant Disease Prevention Program of the Plant Disease Survey, and Idaho Agricultural Experiment Station officials. The first reports following the discovery of the disease indicated that it was caused by *Ditylenchus dipsaci*, the stem nematode common on alfalfa and clover, but THORNE showed in 1945 that this nematode attacking potatoes was a different species, which he named *D. destructor*.

Special surveys on this pest show that its present distribution in the United States is restricted to one region in Idaho involving about 20 fields on 13 farms in 8 sections of land. In December 1945, its presence in Prince Edward Islands, Canada, was reported by the Department of Agriculture, Ottawa, Canada.

It is believed that environmental and climatic factors, crop rotation, natural enemies and limited host range, all combine to reduce effectiveness of spread and rapid build-up of the pest. The potential importance of this disease has resulted in very strict control measures and in plans for intensive research on methods of eradication.

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* Communication from the official correspondent of the International Institute of Agriculture, Mr. PAUL R. MILLER, Pathologist in Charge, Plant Disease Survey, Division of Mycology and Disease Survey, Beltsville, Maryland, U. S. A.

INVASION OF *CALOCORIS NORVEGICUS* (GML.) IN THE COMMUNES OF THE VESUVIUS REGION *

In 1934 and 1935 it was observed that in certain zones of the communes of the Vesuvius region, and in particular at Torre del Greco and at Resina, early French bean crops were damaged by a bug, *Calocoris norvegicus* (Gml.). This insect is very common in the Naples countryside, but until then or at least in our time, it had not caused any appreciable damage to cultivated plants.

The biological study of this insect was effected in the Torre del Greco country where the attack was most severe. In both 1934 and 1935 the newly hatched larvae appeared during the second decade of March, and hatching continued for over a month, namely, up to the end of April. The growing period, from the larva to the adult, varies according to when the egg is hatched and the climatic conditions of the season, and lasts from about 22 to 30 days. Larvae hatched on April 7, 1935 attained full development on May 3, that is to say in 26 days. Other larvae hatched on April 26 became adult insects on May 18, namely, in 22 days. The latter remained 6 days in the first stage and 4 days in the second, then 4 days in the first nymphal stage, 3 days in the second and 5 days in the third. The length of the period of these different stages may vary according to the temperature and the food supply of the insects. The intervals in hatching are due to the different locations of the eggs with consequent exposure to different temperatures.

The newly hatched larva is fairly agile and is about 1 mm. long. For the first few hours it is a straw yellow colour which subsequently changes to grass-green. Shortly after hatching, the larva starts out to find food, makes for a wild or cultivated plant, reaches the bud and sinks its mandibular maxillary organs into the young tissues to suck up the juices. Although it prefers the buds, the larva also attacks the leaves and stem. After having fed well, like the larvae of other ages, it has the habit of stopping for a while to rest. It then finds a shelter, generally a leaf of the same plant, under which it hides and where it remains practically motionless until it has again to seek for food. If disturbed, it rapidly makes its escape under other leaves of the same plant or to other plants close at hand. As they get older the larvae become even more agile. At night (at least as far as I could see in the colonies bred in the Entomology Laboratory at Portici) the insects do not feed but remain motionless from the cold under the leaves, and renew their activity in the morning, fairly early, according to the temperature. Six to seven days after hatching, the larva sheds its skin, a fairly rapid operation, generally at night or in the early hours of the morning. The insect

* Note from Dr. VINCENZO LUPO, transmitted by Prof. FILIPPO SILVESTRI, Director of the Laboratory of Agricultural Entomology, Portici, Italy.

splits its skin longitudinally along the back and up the front, so that first the head and the thorax emerge, then by slow movements, the abdomen and legs and lastly the antennae are freed. As soon as it emerges, the new individual moves slowly, but after some 15 minutes it begins to run about and its colour changes from greenish yellow to grass-green. The skin remains a very short time attached to the plant where casting took place, as the slightest breath of wind blows it away The other sheddings are effected in the same way.

At first the adult is a uniform green colour and its movements are slow. After 15 to 20 minutes it becomes more active and starts running about in search of food, but does not yet try to open its elytrons. At the end of an hour the characteristic brown spots appear on its pronotum, then other marks on the hemi-elytrons.

Adult *Calocoris* from eggs hatched in mid-March can be seen from the beginning of the second decade of April. Their number increases rapidly, so that nymphs are no longer encountered in the third decade of May.

The adult insects continue to feed on the same bean plants giving preference to the floral buds and the young pods. Very frequently, however, they are found on rye, barley and other gramineous plants when in the ear ; they sink their stylets into the young growing grain and suck up the juices.

From the middle of May they begin to couple and oviposition takes place during the third decade of this month and in June. The females leave the herbaceous plants which served them as a source of food and settle on grapevine supports ; in this region, these supports are of barked chestnut wood, about 2 to 3 metres long and 4 to 6 cm. in diameter and sunk into the soil at a depth of approximately 25 cm.

For laying their eggs the females choose the oldest stakes which, through weathering, split longitudinally in various ways and have a less hard surface. The eggs are normally laid in twos, on the topmost part of the stakes preferably along the edges of the longitudinal cracks, where the females can more easily attach themselves to sink in their ovipositor. Each pair of eggs shows the two joined together and placed one on top of the other according to the vertical position of the support. The egg entirely sunk into the wood has its transversal axis directed slightly obliquely in relation to the surface of the stake, while the opercular part remains at about 1/2 mm. from this surface. The female when it gets ready to lay, goes over the stake slowly exploring with its antennae and rostrum to find a suitable point. Once found, it stops, clutches on firmly with the claws of its pretarsi to the cracks in the stakes and, keeping its head either down or up, it sinks its buccal stylets into the wood exploring it up to a certain depth. It withdraws its rostrum, again sinks it in a second and even a third time, then, without changing the position of the legs and remaining firmly attached to the stake, it raises its ovipositor, until that moment held in a normal position, and inserts it in the exact spot from where it has withdrawn its rostrum. After having pushed two or three times so as to get the ovipositor well into the wood, the insect contracts its abdomen several times in order to emit the egg. Generally,

Calocoris again drives its buccal stylets into practically the same spot, and introduces the ovipositor to deposit a second egg alongside the first. After having laid its two eggs, the insect slowly moves along the stake to seek a second spot for egg-laying, usually close to the first, and repeats the operation. It takes at least a minute to lay its two eggs, in general from 40 to 60 seconds, while 7 to 10 minutes elapse between each laying of two eggs. I saw females which laid up to 5 pairs of eggs in sequence on the same stake before flying off in search of food.

The insect, although it prefers chestnut-wood props, also lays in the cankered wood of different trees, such as the olive and the poplar, as well as in the corky layer of vine-stocks.

I did not subject eggs to development to prove that they hatch in the spring of the following year, but I am practically certain that, in Campania, *C. norvegicus* has only one generation a year, as I have never found specimens of this species during other periods of the year despite my investigations in the invaded zone, while, in winter, I observed on a chestnut-wood prop, brought in May into a closed locality, fertile eggs of this hemipter.

The damage caused by *C. norvegicus* to plants is more or less severe according to the number of insects and consequently punctures made, and also the number of plants or parts of plants they feed on.

In the case of early green beans, the leaves, flowers and pods are attacked. When the leaves are fully developed, they turn yellow, then wither at the place of the puncture When they are still developing or when they are still in the bud, small and folded up, one puncture of the insect can pierce them in several places, and then, besides yellowing, necrosis of the affected cells occurs. These leaves subsequently show irregular growth, and the cankered parts break and are pierced with unevenly shaped and different sized holes (1 to 12 mm. in diameter).

The floral buds cease development in consequence of the punctures and show small brown spots due to necrosis of the cells in the parts where pierced, after which they yellow and drop off the stem. This shedding is accelerated if the insects sink their stylets into the peduncle tissue. The pods are also damaged by *Calocoris*, which prefer them, as well as the floral buds, to all other parts of the plant. As a result of these insect punctures, the pods, especially if young, remain rachitic, twisted and show small necrosis marks, In the case of numerous punctures, they yellow, become detached from the peduncle and fall.

C. norvegicus was observed not only on French beans, but also on fennel (*Foeniculum vulgare* var. *dulce*) which is greatly sought after especially by larvae in the first stage, though this plant does not appear to suffer excessive damage. It has also been observed on the potato (*Solanum tuberosum*) and the tomato (*S. lycopersicum*), but these plants are less preferred. Besides the plants, the adult insect feeds on the floral buds and pods of the cabbage (*Brassica oleracea*) and turnip (*B. rapa*), ears of rye (*Secale cereale*) and barley (*Hordeum vulgare*) : the former suffer the same damage as French beans, the latter hollowing or even destruction of the caryopses. Among

the wild plants sought by this insect, mention may be made of the corn-poppy (*Papaver rhoeas*) and the field cabbage (*Brassica campestris*).

One effective means of control is direct collection by mechanical collectors. Those which were employed at Torre del Greco were the shape of a funnel with an oval opening measuring about 35 × 28 cm. crosswise and 20 cm. high. A cloth bag was attached below the collector. The operators hold the collector in the left hand at the foot of the haricot plants, while with the right they shake the plant over it, so that the insects fall inside. Afterwards they are destroyed either with boiling water or with a 5 per cent. solution of emulsified oil.

Treatments with 0.15 per cent. nicotine and soap, as also with tobacco extract with phenol, are not very effective, as it is difficult to reach the insects which hide under the leaves of the plants, which are small in size. On the other hand, the hemipters escape at the slightest movement of the plant and the adults fly off at the first jet of liquid sprayed. The best system of control which has given complete results by radically eliminating invasion, consists in pulling up, in winter, the vine props and disinfecting them and destroying the eggs they contain. The props are disinfected by keeping them immersed for about three days in a 10 per cent. solution of mineral oil. Another good method is, when possible, to put the stakes in a furnace at a temperature of 70°C., or to coat them with tar. With this latter system the eggs of this bug and of others such as *Halticus saltator* (Geoffr.) and *Thamnotettix fuscovenosus* Ferr. can be destroyed, while the duration of the prop is increased.

INTENSIVE DEVELOPMENT OF THE THISTLE BUTTERFLY, *PYRAMEIS CARDUI* L. (LEP., NYMPHALIDAE), AND AN *APANTELES* ITS PARASITE, IN THE HIGHLANDS OF ERITREA *

I. General information on *pyrameis cardui* in Eritrea.

Eritrea is one of the many countries infested by *P. cardui* which sometimes develops intensively in the regions of the highlands and its slopes. This species attacks, more or less violently, some wild Malvaceous plants such as *Malva verticillata* L., *M. silvestris* L., *Lavatera* spp., etc. and some wild Composites of the Carduaceae group, such as various *Carduus*, *Carduncellus*, *Cirsium*, *Echinopus*, etc. Whether the invasion is on a small or large scale, however, the herbaceous plants of the wild flora rarely suffice to feed the caterpillars of *Pyrameis*, which also attacks the globe artichoke

* Communication from Prof. Giuseppe Jannone, Chief of the Entomological Section, Department of Agriculture, Asmara, Eritrea.

(*Cynara scolymus* L.). For the last 3 or 4 years this Carduaceous plant has been one of the most commonly grown irrigated horticultural crops on the Eritrean highlands, where it finds a soil and climate particularly suited to rapid growth and abundant yields. The cardoon (*C. cardunculus* L.) is also attacked, though it is not cultivated to any great extent in Eritrea.

The adults of *P. cardui* are, in Eritrea also, stationary or migratory, according to year, but chiefly according to season. When they emigrate, they nearly always join other Lepidoptera : Nymphalidae, Pieridae, Lycaenidae, etc., to cross the highlands following or almost following the parallels. This migration takes place at two distinct periods of the year : first from west to east, then from east to west, or inversely, depending on the alternation of the rainy seasons, as I already indicated in a note published in 1944 (*Boll. Soc. Ital. Med. e Igiene Trop., Sez. Eritrea*, Asmara, 1944, Vol. IV, No. 3, pp. 453-461) and which I intend to explain in greater detail in a second note at an early date.

Contrary to nearly all the other species which this moth joins in its migrations, *P. cardui* can develop to a considerable extent even and particularly on the highlands of Eritrea during the heavy rains (July to September), that is, between two successive migrations, in both directions. This peculiarity allows of two possibilities which may either or both together correspond to reality : either the plateau, in this region of East Africa, is the preserve of the species where the butterflies originate which later head for the east or the west during the two aforementioned periods of migration, or else this preserve is merely maintained by specimens coming from afar which stop there when the swarms of butterflies cross over. Whatever the reason, it is definitely known that *P. cardui* frequently occurs in large numbers in the regions of the highlands and its slopes, where, occasionally a combination of favourable circumstances lead to a serious invasion, as was the case, for instance, during the summer of 1945.

II. Invasion in the highlands during the summer of 1945.

One of the centres of the region where the development of *P. cardui* was then most intensive, is the locality of Sembel, in south-west Asmara, at an altitude of about 2350 m. and where a certain number of small horticultural enterprises belonging to Europeans are grouped. The Italian Government had established them in order to supply work for some farmers and at the same time to furnish more vegetables to the town of Asmara where the population had increased considerably. From 1943, the globe artichoke was grown very extensively in these concessions, but the yields of this crop exceeded all expectations during the summer of 1945. A few other secondary breeding centres of the insect were located in the districts of Gaggiret, Godaif, Siero-Vaccinogeno, Paradiso, Acria, Ferrovia, Bet Gherghis, etc., all situated in the environs of Asmara, but the damage was not as serious as at Sembel.

Extensive egg-laying was observed during the month of June and a large part of July; that is, one or two months after the passage of a few occasional flights of butterflies which had crossed the highlands from east to west. Moreover, sporadic egg-laying had already occurred in May, and continued in August and September, and in a few cases up to mid October.

From the second fortnight of August a very large number of caterpillars of all ages were observed, many of which had finished growing and turned into pupa on the leaves of the host plants, other neighbouring plants or on dead props of all kinds. In the same period, throughout the month, in September and October, at different points of Asmara and within a radius of 10 to 15 km. about the centre, numerous full-grown insects mating or isolated and feeding on the flowers of different plants were noted.

The first adults of the generation hatched during June-August were seen in the first ten days of September, and became increasingly frequent during the second fortnight of this month and in October. Nearly all the adult insects hatched in the region joined those which emigrated from the western to the eastern slopes, during part of September, October and part of November.

Pupae formed about August 30 or 31 in the laboratory produced adults on September 9 and 10, and nymphosis was completed in 10 or 11 days. A few days before the emergence of the fully developed insect, the pupa developed a darker tint, lost the golden glints of the edges and other points, and revealed by transparency some of the red markings of the wings of the adult. When the adult is freed, the skin of the pupa appears very delicate, whitish and translucid.

The evolutive cycle of *P. cardui*, on the Eritrean highlands, lasted from the end of June to practically the last days of November. Thus, in a period covering the entire rainy season followed up by two months dry weather, there was the complete development of one generation and the partial development of another. In October-November, the number of specimens in the caterpillar, pupa or adult stage gradually diminished so that there was no impression that a second generation had completed development. This growing scarcity of the insects first and then their temporary disappearance were due to several factors: for the caterpillars it was the enormous spread of an endophagous parasite, which will be discussed further on, and which also contributed, as after-effect, towards reducing the number of pupae and adults; the pupae, for their part, suffered the direct action of another parasite of which I was unable to obtain the adult, lastly, the perfect insects were faced with a season which did not allow them to complete their development (drought and low temperatures), so, to escape the severity of the climate of the highlands, they emigrated in October and November to the eastern slopes, joining other passing insects, or else alone. At all events, it may be affirmed that in December 1945 and January 1946, *Pyrameis* were no longer seen on the highlands, so that it could be taken that this species had temporarily disappeared from this region. The fortunate consequence of this phenomenon was a vigorous recovery of all the arti-

choke irrigated fields, at Asmara and in the environs, the crop not having suffered in any way from the low night temperatures and frosts of December-January, since the artichoke, like the cabbage, turnip and other truck crops, is one which supports best these severe climatic conditions.

In the region of the eastern slopes, however, namely, in the zones of Faghenà, Ficcè, Merara, etc., situated at an altitude of 1700 or 1800 m., where sporadic crops or isolated plants of artichokes and cardoons grow, the biological development of the insect lasted longer and there were two complete generations, and even more, during the rainy season and winter mists. I also noted *P. cardui* attack on several plants in November and December, 1945.

III. Action of an endophagous parasite belonging to the genus *Apanteles* on *Pyrameis*.

If the number of specimens of *P. cardui* had continued to increase on the highlands in September-October-November at the same rate as in July-August, probably there would not have been a single artichoke plant left in any of the centres of Upper Hamasien. Fortunately, the spread of this voracious moth slackened and then was definitely checked, as already stated, by one of its powerful enemies which, finding an enormous quantity of caterpillars to parasitize and excellent ecological conditions, bred very rapidly in large numbers because of its faculty of breeding more intensively than its victim.

The enemy in question was a small Braconid belonging to the genus *Apanteles*, according to the determination of Mr. G. E. J. Nixon of the Imperial Institute of Entomology in London, to whom I express my thanks. As soon as I will be able to learn the identification of the species (Dr. S.A. Neave, Director of the Imperial Institute, wrote me on March 18, 1946 that Mr. Nixon was working on the revision of the *Microgasterinae*), I will return to this subject in greater detail.

I succeeded in obtaining a fair number of specimens of this *Apanteles* direct in the laboratory from *Pyrameis* caterpillars collected from the most diverse points of Asmara and its environs during September 1945. During the same period, I also frequently collected clusters of small white cocoons of this parasite which, kept separate, produced specimens of the same species as those which emerged from the *Pyrameis*.

I found that, in my laboratory, the *Apanteles* larvae all emerged practically simultaneously from the *Pyrameis* caterpillar or that, at all events, this emergence did not last more than about thirty minutes. These larvae remained grouped close to their victim and shortly after they began to emit filaments which, arranged in a sort of wide-meshed net, served to enclose a silky mass of a white or yellowish colour. It was inside this mass that, carefully hidden and protected from outside influences, the larvae each formed a whitish cocoon; thus, all these small cocoons were grouped into

one cluster, and were difficult to separate, although they remained fairly distinct.

The adult insects began to emerge in large numbers in the laboratory about September 20, 1945, and to an increasing extent up to October 10.

In order to give a rough idea of the rate of emergence of the adult *Apanteles*, duration of nymphosis, minimum, maximum and average number of symbiotic larvae emerging from each parasitized caterpillar, I have grouped below the results obtained in the laboratory with a batch of 16 parasitized *Pyrameis* caterpillars collected in the Isabettini farm, at Sembel, during the first two decades of September 1945. It is to be noted that the average *minimum* and *maximum* temperatures of the breeding room were respectively 19 and 22°C. throughout the period from September 6 to October 11, with an absolute *minimum* of 15°C. and an absolute *maximum* of 25°C. As regards outside temperatures, for the same period, these varied greatly, especially the average *minimum* which fell to about 8-9°C. Consequently the average duration of the biological development was much shorter in the laboratory than it would have been outside.

Catepillars parasitized	Date of cocoon formation	Date of emergence of adult insect	Duration of nymphosis (days)	Number of adult insects obtained
1	6-IX-45	20-IX-45	14	39
2	8-IX-45	23-IX-45	15	23
3	9-IX-45	23-IX-45	14	36
4	11-IX-45	23-IX-45	12	18
5	11-IX-45	24-IX-45	13	28
6	11-IX-45	24-IX-45	13	35
7	12-IX-45	24-IX-45	12	18
8	10-IX-45	25-IX-45	15	49
9	11-IX-45	25-IX-45	14	24
10	11-IX-45	25-IX-45	14	19
11	14-IX-45	27-IX-45	13	34
12	15-IX-45	27-IX-45	12	67
13	25-IX-45	8- X-45	14	13
14	27-IX-45	9- X-45	13	46
15	28-IX-45	9- X-45	12	25
16	28-IX-45	10- X-45	13	26
		Total . . .	213	495
		Average. . .	13.31	31

Apanteles nymphosis: *minimum* duration 12 days
average » 13.31 »
maximum » 15 »

Minimum number of adult *Apanteles* emerged from each parasitized caterpillar: 13
Average » » » » » » » » » 31
Maximum » » » » » » » » » 67

Observations in the field indicated in short, that in the Sembel farms, at least 95 per cent. of the *Pyrameis* caterpillars did not succeed in forming their pupa during September and part of October because of the action of this *Apanteles* which proved most effective although not being a specific parasite. I even believe that its action would have been still more effective if it had not been hindered by epiparasites which at a certain moment made their appearance, as I noted in some cases in the laboratory breeding experiments.

IV. Control and recovery of seriously damaged artichoke crops.

In order to prevent more serious damage — or at least to limit it — to the artichoke plantations in Sembel and other centres infested by *P. cardui* from the beginning of the second fortnight in August 1945, treatment with lead arsenate in 0.5 per cent. water suspension was recommended for all wild Carduaceous plants within a radius of at least one kilometre about the fields. This treatment becomes problematical during the rainy season, but to avoid immediate washing off of the application, it should only be given on sunny days. There was no likelihood of this chemical control being a danger to livestock, as animals rarely graze plants as spiny as the wild *Carduaceae*. In effect, in October-November when all the plants of the highlands are more or less grazed to the ground, the Carduaceous plants still form impenetrable, tall-growing thickets, half dried up and in flower, or entirely withered and already stripped of their flowers.

On the other hand, in order to prevent poisoning of the flower-heads and leaves of the artichoke (which are frequently given as green forage to milch cows, draught oxen, horses and mules, donkeys, goats, etc.), the arsenical treatment of artichokes has always been advised against and control measures in the crop fields were limited to thorough collection of the caterpillars and pupae. The insects thus captured are enclosed in small cages fitted with a 2 mm. mesh metal netting, so as only to allow the escape of adult *Apanteles* and other eventual parasites of the same size. It has to be acknowledged, however, that collecting the caterpillars and pupae did not prove very practical in crops not much attacked by the insect owing to the thickness of the foliage and close spacing. As regards the crops already almost entirely wiped out by the caterpillars, their collection was uneconomical, since it could no longer have an immediate effect in saving the plants still free from attack.

The best solution in this last instance was that which some farmers adopted on my advice, consisting in a series of measures for facilitating the vegetative recovery of plants still standing. First of all the old, eaten or withered leaves were carefully removed; then hoeing was done between the rows, slightly earthing up the suckers or bunches of suckers with a view to promoting the growth of fresh foliage. For about a month, abundant irri-

gation was supplied at intervals of about 5 or 6 days owing to the very low rainfall in September. Lastly, towards the end of December 1945 and in January 1946, the most damaged artichoke fields had fully recovered their growth and gave every indication of a plentiful crop of new flower-heads.

FIRST COLORADO BEETLE FOCUS IN POLAND *

Towards the end of June, 1946 the Colorado beetle (*Leptinotarsa decemlineata* Say) was noted in several potato fields in a district of the Kielce region. The alarm was given and the competent authorities of the Ministry of Agriculture and agricultural organizations inspected the area. The region was thoroughly explored and all beetles found were destroyed. The neighbouring fields were treated with insecticidal dusts or sprays. Strict surveillance of the area in question was organized. The insects which emerged from the ground were collected and destroyed.

Control was organized on a large scale. The region was divided into three zones according to the extent of the menace. Special squads were formed to collect the beetles. Extensive propaganda was undertaken by means of colour posters giving detailed instructions, and small boxes with a glass lid containing specimens of the parasite in the different stages of its life cycle, were circulated throughout the country.

The farmers, schools and people are continually kept informed by the press, broadcasting and the cinema on the threatening danger and on the most effective means of combatting it.

No fresh foci of the Colorado beetle have been reported.

The Polish Plant Protection Service is commissioned with the permanent inspection of the regions and is required to report any further appearance of this parasite, which is considered in Poland as one of the most dangerous.

* Communication from the official correspondent of the International Institute of Agriculture, Dr. JAN RUSZKOWSKI, Polish National Husbandry Institute, Puławy, Poland.

PRELIMINARY MORPHOBIOLOGICAL DATA ON A NEW WEEVIL (*LIXUS LATRO* MRSHL.) DANGEROUS TO CULTIVATED CRUCIFERS ON THE ERITREAN HIGHLANDS *

I. Introduction.

As early as October-November, 1945, during the first period of my stay in Eritrea for investigations regarding agricultural entomology, I noted a serious decay of cauliflower and cabbage crops in some vegetable gardens in the outskirts of Asmara, and especially in those bordering the Mai Belà torrent, crossing in an E-W direction the populated centre, being one of the most fertile regions of Hamasien. The zones on which I then mostly fixed my attention were those of Rione Paradiso, Adì Sogodò, Fornaci del Governo and Ona Menassè, where many cabbages, 1 to 3 months after transplanting showed signs of rapid decay with consequent yellowing and withering of the leaves. These plants offered little or no resistance on being pulled out the ground ; other cabbages in which the parasitic agent developed somewhat slowly or which were not appreciably infested offered, on the contrary, great resistance. Digging up these latter cabbages with a hoe, dissecting and closely examining them, in the so called ' heart ' or medullary part of the stalk could be seen apodal, curved larvae, with the head a ferruginous colour and the other parts of the body a creamy white, in various stages of development, besides a few pupae and sometimes adult specimens of a curculionid weevil.

Because of military operations in Italian East Africa, I subsequently lost all my notes on the subject together with the material collected in 1939. On my return to Eritrea in 1942, one of the insects on which I renewed my investigations was in effect the cabbage curculionid ; but owing to other more urgent work connected with my duties I could not start observations again until 1943. This time I extended my investigations to many other truck gardens in the environs of Asmara, for instance in the Siero-Vaccinogeno, Ex Ospedale ' 77 ', Acria, Sembel, Bet Ghirghis and other zones, always finding them more or less infested by the insect.

I consider it useful for the science and agriculture of this territory to report briefly on the preliminary morphobiological observations regarding the aforesaid Curculionid, postponing to a later date a more detailed contribution on this insect pest.

II. Identification of the species.

On July 5, 1944 I sent for the first time 4 specimens of the insect to the distinguished expert in Curculionidae, Dr. Sir Guy A. K. Marshall, of the Imperial Institute of Entomology, London, requesting him to be good

* Communication from Prof. Giuseppe Jannone, Chief of the Entomological Section, Department of Agriculture, Asmara, Eritrea.

enough to identify the species which, in my opinion, probably belonged to the genus *Lixus*. Dr. MARSHALL replied on October 12 following, specifying that the insect did actually belong to the genus I suggested, but that most likely the species was a new one ; it was necessary, however, to have a long series of specimens in good condition for confirmation.

On April 11, 1945 I forwarded another 10 adult specimens of the Curculionid, which arrived in London in excellent condition for further examination. On April 30 of the same year Dr. MARSHALL informed me that the *Lixus*, in effect, was a new species and that he had decided to give it the name of *latro*.

A few months later MARSHALL published (*Bull. Ent. Res.*, Vol. 36, Pt. 2, pp. 177-180) a note entitled : " New injurious Curculionidae (Col.) from tropical Africa ", in which, together with other species, he describes *L. latro* first found by myself in Eritrea and in recent years proved to be one of the worst pests of vegetable gardening in the Eritrean tableland. This species is allied to the Mediterranean *L. anguinus* L., from which it differs by an additional black stripe on the prothoracic pleurae, the more curved rostrum, by not showing any sign of median carina, and by other characteristics specified by MARSHALL in the aforesaid memorandum.

III. BRIEF MORPHOLOGICAL NOTES ON THE DIFFERENT STAGES.

ADULT FEMALE *. The body is elongated and slender, with subparallel lateral margins, at least for the greater part of the wing-sheaths and the prothorax. When it is not long out of the cocoon and well preserved, it shows a dorsal chromatic brick-red colouring tending to rust, which after 2-3 days or a little over changes considerably as will be described further on. The head is squat, subglobose, with a fine, compact angular sculpture ; the front is depressed at each side and has a deep foveolet in the middle ; the eyes are subelliptical, lateroproximal and blackish chestnut in colour. The rostrum is slightly shorter than the pronotum, without any trace of median carina, fairly strong and very slightly arched ; longitudinally it is transversed dorsally by a median blackish brown band, bordered on each side by a narrow fascia partly covered by a gray or fawn coloured pubescence ; from about the fourth anterior backwards starting from each side is a helicoidal furrow (scrobe) in which the scape of the antennae lies when at rest. The antennae are geniculate-clavate, not very long relative to the size of the body, blackish chestnut in colour hidden by a grey pubescence and composed of 9 visible articulata, of which the scape is longer than any of the other joints, while the first two articulata of the funiculus are equal and the clava, fairly well developed, gradually tapers to the apex.

* The description of the adult female and male insects was obtained from a series of specimens in my possession, and I have only referred occasionally to that of MARSHALL.

Prothorax subconical, about as long as it is wide, more expanded posteriorly than anteriorly and slightly rounded at the base; the posterior width corresponds to that of the base of the elytra which completely cover the abdomen; dorsally it is transvered by three longitudinal naked fasciae, blackish brown in colour, with usually slightly angular sculpture, comprising one median and two lateral, interspaced by four other fasciae covered with a light grey or fawn pubescence. Scutellum small, practically invisible since it is hidden by the wing-cases.

Abdomen elongated; not seen from the back as it is completely covered by the elytra. These are distinctly oblong, with subparallel sides for at least three quarters or four fifths of their length; at about the fourth or fifth posterior they converge in the middle, each ending in a small pointed projection, slightly forked together; the interstices 1-5 are covered with a thick grey pubescence, while insterstices 6-8 are bare and lucidate. The entire lateral margin of the wing-sheaths is covered with a dense and long whitish pubescence.

Legs and sternal region of the thorax and abdomen are covered with a dense whitish grey pubescence, metasternum and urosternites showing, *inter alia*, numerous irregular, bare and blackish areolets, which sometimes change to pale brownish dots on the legs.

Dimensions taken from a series of 10 specimens: length measured at the back with rostrum extended in front: 10.5-15 mm., comprising 2.2-3.8 mm. for the head plus rostrum, 2.5-4 mm. for the pronotum and 5.6-7.2 for the abdomen; width, measured in the middle: 2.6-3.6 mm.

ADULT MALE. Similar to the female, but slightly smaller and more slender.

EGG. Subspherical or slightly ellipsoidal in shape and honey-yellow or lemon-yellow in colour. The *chorion* is very thin and delicate; to the naked eye it appears smooth and shining, and when magnified finely fossulated or dotted.

Dimensions taken from a series of 10 specimens: maximum diameter: 0.7-0.8 mm.; minimum diameter: 0.5-0.6 mm.

FIRST LARVA. Body normally arcuate. Head easily visible to the naked eye, rust colour and with cuticle fairly thick and robust; the rest of the body has a very thin cuticle of a yellowish-cream colour. The larva has a few odd short soft hairs on the sides of the segments of the thorax and the abdomen: short or very short on the former, fairly long, combined in groups directed backwards towards the last urites. On the small pedal mamillae of the pro-, meso- and metasternum small, stiff strong bristles are to be found. Ventrally, the abdomen segments are covered with practically invisible short soft hairs.

Dimensions taken from a series of 10 specimens: length measured a few days after hatching and sideways, on the arcuate bent body: 1.2-1.4 mm.; mean height of the body measured at the side: 0.5-0.6 mm.

ADULT LARVA. Corpus normally arcuate as with the larvae of other Curculionidae. Caput subglobose, very strong, with chitinized and resistant cuticle rust-coloured, except for the metopic suture, which is honey coloured and two other narrow longitudinal stripes — one on each side of the aforesaid suture — of the same colour. The buccal apparatus is fairly strong. Thorax and abdomen are creamy white in colour, seemingly glabrous but actually covered with minute soft short hairs. The prothorax shows dorsally two transverse plaques slightly more chitinized than the surrounding parts and a yellowish biscuit colour, one at each side of the median longitudinal line.

Dimensions taken from a series of 10 specimens: length at time of maximum development, measured at the side of the arcuate body: 13-15 mm.; height at middle, measured at side: 4-4.5 mm.

PUPA. As soon as formed and for several days afterwards, the colour is a uniform creamy sort of yellow: after about 12-15 days or more, the eyes darken as also the articulate parts of the legs and rostrum; the other parts undergo slight chromatic changes. The corpus is appreciably longer than it is wide; the abdomen is slightly and normally bent bow-like towards the ventral side in correspondence with its extremity. Seen from the venter, it presents the rostrum bent forwards and leaning against the sternal side of the corpus, surpassing slightly the tibial-tarsal articulation of the fore legs. The pterothecae, which can be raised like all the other appendices of the thorax, cross the median and hind legs bent ventrally to the body, which very slightly jut out at the sides of the pterothecae with the femoral-tibial articulation. The distal extremity of the said wing-cases reaches the middle or the posterior margin of the fourth urite. The abdomenal extremity on the ventral part has two small rust-coloured bristles.

Dimensions taken from a series of 10 specimens: length: 13-15 mm.; mean width measured on the back: 3-4 mm.

IV. BIOLOGICAL DATA.

Every year the adults of *L. latro* start to appear about the beginning of January, when the cabbages transplanted from early October onwards, are in full development; the invasion continues intensely for a period of 4-5 months up to practically the end of May, afterwards slightly diminishing. The majority of the adult insects always originate from old plants left to seed, and which live much longer than the normal cabbage crops (up to 11-12 months or even more). Such plants succeed in overcoming the vegetative crisis which takes place during the periods of greatest larval 'load' inside the stem, often sending out laterally 1, 2, 3 or more shoots, which, however, do not produce very flourishing inflorescences. Some plants die before and during the flowering period.

The adult insects feed on the cabbages, removing the green cortex of the stalk, on which they make small holes in diameter averaging 1 mm. or

little more, or the epidermis of the foliar rib or that of the leaves with part of the mesophyll. They live for a long time, hidden in shelters throughout the rainy season, and afterwards (end of September and part of October); in the open, however, very few are to be seen at all times. The insects begin to mature in July-August, mate and start depositing the eggs immediately on the old plants of the crop cycle of the rainy season, but especially on nursery seedlings already pricked out and on those not long transplanted towards the end of September and at the beginning of October. Throughout October and November, 1944 and 1945, I had no trouble in collecting eggs and newly hatched larvae, while from the end of December onwards I often obtained larvae fully grown or else already in an advanced stage of development. In March and April, however, I still came across small larvae.

Each egg is laid separately, placed inside a small cell, 1-1.5 mm. in diameter and about 2 mm. or a little more deep, which the female excavates with the buccal appendices located at the extremity of the rostrum. The point of oviposition on the green surface of the epidermis of the stalk of the seedlings is easily distinguished, as it is indicated by a brownish halo of the subepidermal cicatrized tissue, 4-5 mm. in diameter, caused through the female feeding on the stalk before perforating it. In the case of slender stalks, of a diameter of 4-5 mm., the egg is found to be deposited in the centre of the soft medullary zone; with better developed plants, the egg is always located subcortically or intracortically.

The same female can deposit 2-3 eggs a few centimetres apart in the case of seedlings or even more with older plants. The stalk of one old or well developed plant can contain 15-25 or more eggs, deposited at various times by different females.

The larvae live in straight or winding galleries, excavated longitudinally obliquely or transversally first in the intracortical zone and afterwards in the medulla, galleries which vary in diameter from 1-1.5 to 5-6 mm. in diameter according to the age of the specimens. The larval cuniculi are often partially or completely obstructed by excrement and chewed vegetable matter, which are compressed in the tunnels by the larvae; the products of larval activity frequently exude through small openings made in the wall of the stalk, forming on the outside small lumps which later break up and fall to the ground. The larval stage lasts about 2 and a half to 3 and a half months, during October-January, always with dry weather and a nocturnal temperature averaging 4-5°C. (sometimes it falls to 0°C.) and a diurnal temperature with a mean of 20-25°C. In the February-June period, the larval stage is shorter owing to more favourable climatic conditions.

Pupation takes place inside the stalk and in a kind of niche slightly longer and wider than the pupa, with the walls formed mostly of chewed shreds compressed by the last larva and also by lateral movements of the pupa, directly under the cortex or a little further in. Nymphosis lasts from 13-14 to 24-25 days according to the temperature of the season.

The adult insect, as soon as it has emerged from the pupal skin, is still rather soft, yellowish cream in colour, except for the rostrum, the eyes,

the median part of the pronotum, articulate parts of the legs and a few other zones, which are a blackish or rust colour. After a few hours or the next day it assumes a chromatic brick-red tending to rust livery; successively, and as already stated, it acquires its final colouring. During these phases it remains inside the niche until the cuticle has hardened, a proceeding which requires 2 or 3 days or a little more after leaving the skin. In this condition it still remains in the niche for a few days; it then goes out into the open through a small opening made in the wall of the stalk. The adult insects have the habit of feigning death, folding back the antennae and legs onto the body and remaining absolutely motionless for some minutes as soon as they are touched or in any way disturbed.

V. Number of generations in a year.

In regard to the biological cultural characteristics of cabbages grown in Eritrea, the development of *L. latro* does not appear to undergo any well defined check during the year, since, in effect, eggs, larvae, pupae and adults can be collected in any month. Probably the species produces two and even three generations in a year, but the periods in which the insects in the stages are most abundantly and easily collected are those indicated earlier on.

VI. Plants infested and nature and extent of damage.

L. latro, in the Eritrean highlands, attacks the cauliflower, cabbage and sometimes even the radish. The plants in a certain zone may be infested to the extent of half or two thirds. The tissues which first deteriorate as a result of larval activity are those close to the margins of the tunnels. In extreme infestation, the entire medulla may be reduced to a brownish, malodorous pulp. In October, 1945 it was found that many plants died off rapidly through the intervention of another parasitic cause, probably of secondary origin, which produces root rot. Possibly this can be attributed to a *Phoma* (*Ph. oleracea* Sacc. ?). The spread of this fungus would be facilitated by the adult *L. latro*, which shift continually from one plant to another during the feeding and oviposition periods.

VII. Natural enemies of *lixus*.

Up to May, 1946 no parasite was obtained, but almost certainly will be found in the future. Flaccid and blackened larvae found in the stalk of old plants with the medulla reduced to pulp, had, in my opinion, died through the action of pathogenic agents which had taken up their abode in the unhealthy environment created by the activity of the larvae themselves.

VIII. Artificial control.

The artificial control of *L. latro* could be based on the following expedients and systems:

(*a*) It is necessary to inspect thoroughly the seedlings selected for transplanting, so as to plant in the field only those which do not show

on the epidermis of the stalk blackish, subcircular or ellipsoidal spots, corresponding to the eggs or newly hatched larvae of the insect. The infested seedlings are burnt or destroyed in quicklime.

(*b*) The plants which during growth show signs of infestation (consisting in yellowing and withering of the leaves or the appearance of lumps of plant waste exuded through holes made in the wall of the stalk) are to be pulled up immediately and destroyed as indicated in the preceding paragraph.

(*c*) The more hardy plants which are frequently left scattered in the field for seed production, should also be examined occasionally, in order to prevent the insects concentrating and consequently a fresh outbreak of Curculionid infestation. If any signs of infestation appear, the affected plants should be uprooted and destroyed.

(*d*) After having removed the cauliflower inflorescences and the cabbage heads, the stalks of the plants which frequently contain *Lixus* larvae, pupae and newly formed imagos in the medulla, should be uprooted immediately. These stalks must not be heaped on the dunghills or in any other part of the farm, but destroyed straightaway as indicated.

(*e*) In order to entice many adult insects to deposit eggs on old plants already cropped, it would be advisable to leave along the borders of the fields 2 or 3 rows of stalks with few leaves, which could be removed and destroyed when carrying the maximum load of insects. These plants could also be sprayed with a 1 per cent. aqueous suspension of lead arsenate so as to poison the adult insects which come for feeding and oviposition.

CROP PESTS ACCIDENTALLY INTRODUCED INTO POLAND DURING THE WAR *

The recent penetration into Polish territory of very dangerous crop pests is the consequence of all preventive measures having been suspended during the period of hostilities and during that immediately following. A methodical control of these pests has now been undertaken in order to destroy them or at least to localize the infection centres.

It may be supposed that it was in 1944 that there appeared in the region of Cracow the common bean weevil (*Bruchus* [*Acanthoscelides*] *obtectus* Say) introduced with imported haricot beans. The only infection centre known since 1945 is that of Cracow, and it has been definitely destroyed. It has not yet been possible to ascertain from where or how this parasite

* Communication from the official correspondent of the International Institute of Agriculture, Dr. JAN RUSZKOWSKI, Polish National Husbandry Institute, Puławy, Poland.

arrived. At all events it is to be feared that this species might find conditions in Poland favourable for its acclimatization in depots of beans for seed or intended for food.

Another species of parasite reported by our services in considerable numbers among haricot beans imported for food, is *Spermophagus subfasciatus* Boh., which was introduced with UNRRA goods. There is good reason, however, to hope that this parasite, which does not stand the cold well, will not find it so easy to become acclimatized as the preceding species.

MANUFACTURE AND USE IN SPAIN OF NEW SYNTHETIC INSECTICIDES *

In 1943 use began to be made in Spain of agricultural insecticides based on dichlorodiphenyltrichlorethane (DDT), after having experimented with the original product ('Gésarol'), preparation of the Geigy firm at Basel, Switzerland, adopted mainly in the control of the Colorado beetle (*Leptinotarsa decemlineata*). The product proved more effective than arsenates against full grown insects and was found to be practically harmless for man and livestock, at the usual doses and in the usual form of application (spraying of a 1 per cent. suspension in water, with 5 per cent. DDT). The powder or inert medium generally employed is kaolin.

Owing to the relatively high price of the Swiss product, the Spanish chemical industry tackled the problem of the manufacture of the DDT series of insecticides and put on the market, in 1945, several insecticides for agricultural and domestic use, similar in quality to the imported preparations, some of which proved to be even more effective than the original insecticides in the course of comparative experiments effected by specialized technicians of the National Institute of Agricultural Research.

At present the use of these new insecticides is fairly general and these products have earned the favour of most of the farmers, particularly, and with great success, in the control of the Colorado beetle, certain pests of lucern (*Colaspidema atrum*, *Phytonomus variabilis* and *Phlyctaenodes sticticalis*), the cabbage white butterfly (*Pieris brassicae*), etc. The use of these insecticides of the DDT series is also becoming general in the control of insects attacking fruit trees (*Anthonomus pomorum*, *Cydia pomonella*, etc.) and the vine (*Polychrosis botrana* in particular).

On the other hand, the action of the present DDT preparations against aphids and scale insects is adequate and for this reason, despite their double effect by ingestion and contact, they are only applied in substitute for lead and calcium arsenates.

* Communication from the official correspondent of the International Institute of Agriculture, Sr. José del Cañizo Gómez, Central Station of Phytopathology, Madrid, Spain.

In Spain, present manufacture attains an output of 1000 to 1200 kg. per day of the active product (technically pure DDT) which is equivalent to 25,000 kg. per day of agricultural insecticide with a percentage of DDT in the pure state which varies from 5 to 7 per cent., but which generally runs at 5 per cent. This output capacity is adequate and even exceeds the present and anticipated requirements for Spanish consumption.

It is not to be expected that DDT will do away with or substitute completely the use of arsenates and in particular lead arsenate either for crops for which the toxicity of the insecticide is not sufficiently compensated by the lower cost, or else against pests more resistant to DDT such as has been found especially in the case of caterpillars of *Prodenia litura* and the Moroccan locust (*Dociostaurus maroccanus*) and different species of *Ephippigerinae*.

The principal manufacturing plants for DDT in Spain are the 'Laboratorios Españoles Zeltia, S.A.' of Porriño, Pontevedra, which put up an insecticide called 'ZZ' and other various insecticides for domestic use against flies, bugs, clothes-moths, cockroaches and lice; the 'Fabricación Nacional de Colorantes y Explosivos, S.A.' at Barcelona, one of whose products is beginning to be sold under the name of 'Uni-agrícola'; the 'Industrias Derivadas de la Hulla', at Barcelona, which sell technically pure DDT to the manufacturers of insecticides known under various trade names ('Doriphol', 'Peck', 'Cruz verde' and others). There are also other small laboratories and companies of lesser importance than the three mentioned, which also manufacture smaller quantities of DDT. The Swiss Geigy firm has set up plants at Flix, Tarragona and at Pamplune, where DDT imported or purchased from other manufacturers, is mixed with inert mediums.

Since the spring of 1944, the 'Insecticidas Condor' Company at Bilbao has been manufacturing another synthetic insecticide; experiments carried out in previous years strangely enough, at the end of the world war, were found to coincide with the investigations effected for the same purpose in Great Britain by the Imperial Chemical Industries, which considered this preparation as a 'war secret'. The Spanish product, based on hexachlorocyclohexane, is sold under the trade name of 'Gélon' and contains 15 per cent. of the gamma isomer of the aforesaid compound ($C_6H_6Cl_6$) also known as gammehexane and by the anagram 666. This product is applied in 1 per cent. aqueous suspension and is as effective as DDT against the Colorado beetle. It is also useful against the *Ixodidae*, *Hypoderma*, etc. This product is also manufactured by the 'Laboratorios Españoles Zeltia', and to a smaller extent by 'Ulargui' of Logroño, whose product ('Gaxano' 666) has not yet been put on the market.

A new and important application of gammehexane, which is now being subjected to tests in Spain, is the disinfection of premises by means of paper bags which on burning volatilize the active product which (at a temperature below decomposition point) is spread by the smoke which rises. Here it is a case of an original Spanish principle distinct from the North American aerosols.

CONTROL TESTS ON INSECT PESTS WITH DDT PREPARATES *

The Phytopatological Observatory for Lombardy (Entomology Section) had been commissioned from the end of 1944, by the Ministry of Agriculture and Forests, to carry out official tests on ' Gesarol ', product manufactured by J. R. Geigy, Ltd., Basel, Switzerland, and containing DDT. The credit of having recognized the valuable and lasting insecticidal properties which had been unknown for 70 years, rightly goes to the chemists and biologists of the firm in question. The first indicative trials for the use of this product in farming had already been effected in Italy in 1943, on request of the Geigy firm, by the author of this communication.

These investigations which present a very wide field of application will require several years because, for each species of insect, it is necessary to perfect the method of application, dosage, conditions, number of treatments, etc. Up to the present only the results concerning two beetles which attack flax have been published. Nonetheless, after three years' repeated and increasingly extended experiments it is fitting to summarize in a brief note the now definitely verified results regarding some species of insects.

Aphtona euphorbiae and *Longitarsus parvulus*. In April 1944 I undertook a preliminary experiment on these two species of flea-beetles in order to try and check these pests which were thoroughly and irreparably devastating flax crops in Italy. In a very large field located near Chiari in the Province of Brescia, treatments were carried out with ' Gesarol ' in the liquid form at 1 and 2 per cent., and dusts at the rate of 10 gm. per sq. metre were also tried. These treatments were repeated 2 and 4 times in separate plots in April, during the period when the young flax plants are 5 to 7 cm. high and when the adults of the two beetles have already emerged from their winter shelter, but have not yet bred or, at all events, have not yet laid their eggs. Any action after this period would be useless as it is practically impossible to reach the larvae.

The results were all positive: the mortality rate of the insects was 100 %. The harvest was absolutely normal with 53 qls. of flax per hectare ; in the control plot the yield amounted to 33.15 qls. *Haltica* attack in this zone in 1944 had been relatively slight ; in previous years the crop was a complete loss.

* Communication from Prof. R. GRANDORI, Director of the Phytopathological Observatory for Lombardy (Entomology Section), Milan, Italy.

The experiment was repeated in 1945, but the results could not be ascertained because on April 25, time when the flax develops, after the treatments which had been given April 15 and 17, the country-side was devastated by the contending forces (German retreat from North Italy).

In 1946, the experiments were repeated on a larger scale in the Marche, Brescia Province and in the environs of Codogno in the Province of Milan. The treatments were applied in March and a part in April according to the budding-time of flax. At the time of writing this note we have already verified the entirely positive result of the experiments. In effect, the flea-beetles which used to swarm over young flax plants when they were hardly 3 to 5 cm. above ground, to a remarkable extent, were completely destroyed a few hours after treatment.

Agrotis segetum. Pavia Province is suffering from a very severe invasion of this lepidopter, the caterpillars of which have caused and are still causing serious damage to forage legumes, maize, wheat, young tomato plants and other vegetable species. We had ' Gesarol ' dusts containing DDT sent at the end of April when the caterpillars crawled along the ground. We found that a large number were killed, but as their emergence to the surface of the ground does not take place simultaneously, but is distributed over a fairly long period, dusting, if necessary, will have to be repeated. The doses which were employed for dust treatments against flax beetles, in the course of that year were reduced to 5 gm. per sq. metre. It seems from the latest experiments that it could be reduced to as little as 3 gm. per sq. metre. The number of treatments which had been 2 and even 4 during the first experiments, has been limited this year to only one to date . It is not to be excluded, however, that a fresh invasion of adult insects from neighbouring fields, will occur. When the first treatment is given very early, in March, for example, definitive results can be obtained against the flea-beetles which started the invasion so that further action no longer seems necessary, though other adults may arrive by flying from neighbouring fields, when it is then necessary to repeat dusting.

Experiments are proceeding against other insects, in particular, *Zabrus gibbus*, *Clysia ambiguella*, *Polychrosis botrana*, *Tropinota hirta*, *Cydia pomonella*, *C. molesta*, *Dacus oleae* and others.

HYDROCYANIC ACID FUMIGATION AGAINST THE OLIVE THRIPS IN SPAIN *

Through the initiative of Sr. Dionisio MARTÍN, agricultural engineer, and organized by the technical Services of the Ministry of Agriculture, with the co-operation of the National Olive Association, of which Sr. MARTÍN is president, from November, 1945 to March, 1946 an intensive campaign was carried out against the olive thrips (*Liothrips oleae* Costa) in the olive groves in the province of Jaén.

The application of the process in question against this thysanopter is the outcome of the work of the late Prof. Leandro NAVARRO, agricultural engineer and Director of the Plant Pathology Station of La Moncloa, Madrid. The treatment has been used since 1912, that is, from the time of the first investigations and experiments effected by Prof. NAVARRO, whose dosimetric tables were later corrected by Sr. Miguel BENLLOCH, present Director of the Central Phytopathology Station of Madrid.

For the aforesaid campaign the Ministry of Agriculture and the General Supplies Commissariat furnished 5000 tents of which 3000 were utilized last winter, distributed in lots of 25 to 120 gangs, composed of an overseer, two specialized workers and four other men for setting up and transporting the tents. The gangs are divided into groups of five, each group being under the direction and supervision of a head foreman.

As the efficacy of the disinfection treatment is diminished through the non-existence of unhatched eggs, and since the temperature should remain between 8 and 16°C., the weather conditions of last autumn caused a delay in operations which only began on November 17, and from this date up to the end of March, in the province of Jaén alone, approximately 1,000,000 olive trees were disinfected, using 110,000 kg. sodium cyanide and 320,000 kg. sulphuric acid.

For future campaigns, in the same province of Jaén, 80 and more squads, namely, 200 in all, will be made available, which will enable all the olive groves attacked by *L. oleae* to be treated within 5 years.

As soon as the zones invaded and having the most urgent need for treatment were reported by the agricultural staff, control was declared compulsory. It was thus possible to carry out operations without taking into account zone limits, treating all the trees, with a view to preventing a second invasion.

With the exception of the director in charge of the campaign, all the personnel worked by contract, the foremen receiving 19 to 25 peseta centimes per tree treated, depending on conditions of terrain and the grove, and the

* Communication from the official correspondent of the International Institute of Agriculture, Sr. José DEL CAÑIZO GÓMEZ, Central Station of Phytopathology, Madrid, Spain.

workers from 9 to 13 centimes per tree. Each gang with 25 tents on an average treated 100 olive trees a day; but, if weather and conditions are favourable, this figure may rise as high as 170-180 trees treated.

The cost of treatment per tree is 3 pesetas, distributed as follows: labour 1.63; cyanide 0.80; sulphuric acid 0.15; the remainder covers expenses for transporting the material, amortization of the tents and sundries.

Of these expenses the proprietors of the olive groves only pay 1.75 pesetas per tree and the National Olive Association, moreover, grants them every possible facility as regards payment.

Taking as a basis the results of the preceding campaigns and not counting other causes which might check production, the technicians of the National Olive Association calculate to obtain an average increase of 12 kg. of olives per disinfected tree, which makes an estimated increase in production of 120,000 qls. of olives, equivalent to 26,400 hl. of oil, which is now valued at 10,000,000 pesetas.

In other producing provinces, particularly in that of Toledo, fumigation campaigns have been carried out on a smaller scale than in Jaén, compared with the extension of the olive groves and the severity of thrips attack.

It is worth noting that, according to the last 'Anuario Estadístico de las Producciones Agrícolas', published by the Statistics Division of the General Department of Agriculture, Madrid, 1945, the area under olive groves in the Province of Jaén covers 340,500 hectares for a total of nearly 27,240,000 olive trees.

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Printed by F. FAILLI, Printing-Office of the International Institute of Agriculture
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